WASHINGTON STATE DEPARTMENT OF ECOLOGY

February 2022

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) AND PHOSPHORUS TREATMENT

For

City of Bellingham
Phosphorus Optimized Stormwater Treatment Two-Chamber System

Ecology's Decision

Based on the City of Bellingham application submissions for the Phosphorus Optimized Stormwater Treatment (POST) Two-Chamber System, Ecology hereby issues the following use level designation:

1) General Use Level Designation (GULD) for Basic and Phosphorus Treatment:

   - Sized at a hydraulic loading rate of 0.62 gallons per minute (gpm) per square foot (sq ft) of bioretention media surface area.
   - Constructed with a mulch surface (2" deep minimum) above the treatment media with a minimum media thickness of 18-inches of treatment media in chamber one followed by 12-inches of polishing media in chamber two. The surface area of chamber two shall be equal to or greater than the surface area of chamber one.

2) Ecology approves the POST System at the hydraulic loading rate listed above, to achieve the maximum water quality design flow rate. Base POST system sizing on the surface area of chamber one. The water quality design flow rates are calculated using the following procedures:

   - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology- approved continuous runoff model.
   - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.7.6 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.

- Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

3) The GULD has no expiration date, but may be amended or revoked by Ecology.

Ecology's Conditions of Use

POST Systems shall comply with these conditions:

1) Design, assemble, install, operate, and maintain the POST System installations in accordance with the City of Bellingham design criteria and the Ecology Decision.
2) Design guidance for the POST system is included at the end of this document.
3) The minimum size filter surface-area for use in Washington is determined by using the design water quality flow rate (as determined in Ecology Decision, Item 3, above) and the hydraulic loading rate (as identified in Ecology Decision, Item 1, above). Calculate the required area by dividing the water quality design flow rate (cu-ft/sec) by the hydraulic loading rate (converted to ft/sec) to obtain the required surface area (sq ft) of the POST system.
4) POST System media (treatment media and polishing media) shall conform to the specifications submitted to and approved by Ecology in the Technology Evaluation Report (TER). A copy of the specifications is contained in Attachment 1
5) Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of stormwater treatment technology.
    - The developer designed the POST system for a target maintenance interval of 1-year. In addition, we recommend a visual inspection every 6-months to determine if the mulch requires replacement. Maintenance includes removing trash, silt, and mulch from the filter surface; replacement of the surface mulch layer; raking of the media; and pruning of vegetation (if present).
    - Owners/operators must inspect the POST systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to the SWMMEW, the wet season in eastern Washington is October 1 to June 30.) After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.
    - Owners must use qualified personnel to conduct inspections of the POST system and they must follow the POST System operation and maintenance guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.

6) Install the POST System in such a manner that you bypass flows exceeding the maximum operating rate and you will not resuspend captured sediment
7) Discharges from the POST System shall not cause or contribute to water quality standards violations in receiving waters
8) Both the single chamber and two chamber system must be constructed with a minimum of 2-inches of shredded wood mulch, 18-inches of treatment media and 12-inches of polishing media
9) The surface area of chamber two shall be equal to or greater than the surface area of chamber one. Base sizing of a two-chamber system on the surface area of the first chamber.
10) Use an orifice at the terminus of the underdrain in each chamber to restrict the flow rate through the media to the design flow rate used for sizing the media.

Approved Alternate Configurations
Phosphorus Optimized Stormwater Treatment One Chamber System

1) The POST system tested through TAPE was partitioned into two separate treatment chambers, with chamber one containing the mulch and treatment media while chamber two contained the polishing media. Designers could also configure the POST system as a single chamber with all three media stages (mulch, treatment media, polishing media) stacked vertically with polishing at the bottom and mulch on the top.
2) The pilot POST system was unplanted, however, the POST system designers can construct the system with a planted primary treatment media bed.

Applicant: City of Bellingham

Applicant's Address: 2221 Pacific St.
Bellingham, WA 98229

Application Documents:

Technical Evaluation Report: City of Bellingham Phosphorus Optimized Stormwater Treatment (POST) System Performance Monitoring Project, Herrera Environmental Consultants, July 2021

Quality Assurance Project Plan: City of Bellingham Phosphorus Optimized Stormwater Treatment (POST) System Performance Monitoring Project, Herrera Environmental Consultants, February 2019

Emerging Stormwater Treatment Technologies Application for Certification: POST (Phosphorus Optimized Stormwater Treatment) System, City of Bellingham, August 2018

Technical Memorandum: Application for Pilot Use Level Designation – Technology Information,
Herrera Environmental Consultants, August 2018

Applicant's Use Level Request:

- General Use Level Designation as a Basic, Enhanced, and Phosphorus Treatment device in accordance with Ecology's *Stormwater Management Manual for Western Washington*

Applicant's Performance Claims:

Based on laboratory and field testing, at a hydraulic loading rate of 0.62 gpm/sq ft. the POST System will meet TAPE performance goals for TSS and total phosphorus.

Ecology's Recommendations:

Ecology finds that:

- City of Bellingham has shown Ecology, through laboratory and field testing, that the POST System is capable of attaining Ecology's Basic and Phosphorus treatment goals.

Findings of Fact:

Field Testing

- Herrera Environmental Consultants, Inc. conducted monitoring of the POST System at a pilot field site in Bellingham, Washington between November 2019 and January 2021. Herrera collected 25 paired flow-weighted composite influent and effluent samples and 17 paired grab samples. Herrera sized the system at a hydraulic loading rate of 0.62 gpm/ft^2.
- The particle size distribution analysis showed the suspended solids were composed of 40 percent silt and clay sized particles, with a D_{50} of 84 microns.
- Fourteen of the 25 qualified composite samples had influent TSS concentrations at or above 20 mg/L. These concentrations range from 20 to 115 mg/L with a mean concentration 37 mg/L. For samples with influent concentrations between 20 to 100 mg/L the bootstrap estimate of the upper 95 percent confidence limit (UCL95) of the

mean TSS effluent concentration was 6.3 mg/L. For the single sample with an influent concentration above 100 mg/L the percent reduction was 97.6 percent.

- Eleven of the eighteen storms sampled for total phosphorus had influent concentrations within the TAPE required range of 0.1 to 0.5 mg/L. An additional storm had an influent concentration of 0.575 mg/L. Based on TAPE requirements, this concentration was capped at 0.5 mg/L before performing the data analysis. Influent concentrations from the 12 samples ranged from 0.108 mg/L to 0.575 mg/L, with an average of 0.217 mg/L. The bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 61.5 percent.
- Maintenance conducted on the system during the monitoring included raking the mulch after 3 months (40 percent of a water year) and replacing the mulch after 10.5 months (83 percent of a water year).

Lab Testing

- Herrera Environmental Consultants conducted laboratory testing on the POST System at the Western Washington University Toxicology Lab. The testing evaluated the flushing characteristics, hydraulic conductivity, and pollutant removal ability of 8 different media blends. Based on this testing Herrera recommended use of Media 7 or Media 2 in the TAPE evaluation of the POST System. City of Bellingham decided to move forward with Media 2. Results listed below are specific to the Media 2 mix.
    - Herrera evaluated Media 2 in an 8-inch diameter by 36-inch tall polyvinyl chloride (PVC) column with an underdrain.
    - Herrera conducting a flushing test on Media 2 using deionized (DI) water during 4 events. The hydraulic loading rate during the first two tests used the Ecology water quality treatment design storm which equaled approximately 12.85 liters per event. The second two tests used approximately 25.70 liters per event. These 4 tests were done after an equivalent of 4%, 26%, 55%, and 99% of a water year had been flushed through the column. Media 2 performed well with minimal flushing of TSS (average effluent concentration of 2.7 mg/L) and total phosphorus (average effluent concentration of 7.3 μg/L). All effluent dissolved copper and dissolved zinc concentrations were below the detection limit.
    - Media 2 had a hydraulic conductivity of 186 inches per hour; however, the designers based their evaluation of the pollutant removal ability of the media on a design infiltration rate of 60 inches per hour.
    - Herrera evaluated pollutant removal performance of the POST System using natural stormwater during 5 events. For one of the events the natural stormwater they augmented the influent water with reagent grade chemicals to attain higher target concentrations for phosphorus.
    - The POST system removed an average of 98% TSS, with a mean influent concentration of 120 mg/L and a mean effluent concentration of 2 mg/L.

- The POST system removed an average of 96.7% total phosphorus with a mean influent concentration of 0.348 mg/L and a mean effluent concentration of 0.020 mg/L.
- The POST system removed an average of 73% dissolved copper with a mean influent concentration of 3.2 µg/L and all effluent concentrations below the reporting limit.
- The POST system removed an average of 93% dissolved zinc with a mean influent concentration of 20 µg/l and a mean effluent concentration of 1.3 µg/L.

Other POST System matters Ecology recommends that the City of Bellingham address:

1. Maintenance and Replacement. How do pollutant removal efficiency and hydraulic capacity decrease over time, and at what point is maintenance or replacement required
2. Conduct loading tests on the filter to determine maximum treatment life of the system.

Technology Description:

The City of Bellingham Phosphorus Optimized Stormwater Treatment (POST) system consists of either a one- or two-chamber rectangular vault designed as a three-stage vertical filtration media bed. Stage 1 is a prefilter consisting of mulch; stage 2 is a primary treatment media bed; and stage 3 is a polishing media bed. The POST System was designed to remove suspended solids and phosphorus from stormwater runoff through settling, screening, filtration, sorption, and biological processing. For illustrations, design specifications, and maintenance criteria contact the City of Bellingham. See Attachment 2 for the Standard Detail of the two chamber system.

Contact Information:

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Applicant website: www.cob.org

Ecology web link: https://ecology.wa.gov/Regulations-Permits/Guidance-technical- assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment- technologies

Ecology: Douglas C. Howie, P.E. Department of Ecology Water Quality Program
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Revision History

Date	**Revision**
September 2018	PULD granted for Basic, Enhanced, and Phosphorus Treatment
July 2021	GULD granted for Basic and Phosphorus Treatment
February 2022	Attached Design Guide

Design Guide

DESIGN GUIDE

City of Bellingham Phosphorous Optimized Stormwater Treatment (POST) System

Prepared for
City of Bellingham, Washington

Prepared by
Herrera Environmental Consultants, Inc.

Note:
Some pages in this document have been purposely skipped or blank pages inserted so that this document will print correctly when duplexed.

DESIGN GUIDE

CITY OF BELLINGHAM PHOSPHOROUS OPTIMIZED STORMWATER TREATMENT (POST) SYSTEM

City of Bellingham
Department of Public Works – Natural Resources
104 West Magnolia, Suite 109
Bellingham, Washington 98225

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February 18, 2022

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1. INTRODUCTION

The Phosphorus Optimized Stormwater Treatment (POST) system is a non-infiltrating structural stormwater treatment system developed by the City of Bellingham (the City) with General Use Level Designation (GULD) approval from the Washington State Department of Ecology's (Ecology) Technology Assessment Protocol – Ecology (TAPE) program. (Figure 1). The POST system consists of a three-stage vertical filtration media bed with underdrain, typically housed in a precast concrete vault but may be constructed in lined earthen excavations with or without structural walls and, as such, can be configured for application in most urban drainage conditions.

Figure 1. Monitored POST System used for TAPE Certification, Located in Bellingham, Washington.

The three POST system media bed stages are typically configured vertically "stacked" but can also be configured "unstacked" with the stages arranged horizontally in series, located in separate vaults or bays.

POST Stage 1 is a mulch prefilter that removes gross solids, debris, oils, and larger particulate matter. POST Stage 2 is a primary media bed optimized for the physical filtration of total suspended solids (TSS), dissolved pollutant sorption, and (optional) plant growth. POST Stage 3 is a polishing media bed specifically formulated for dissolved phosphorus and metals removal.

The POST system can be designed with an external or internal high flow bypass which must be appropriately sized based on the design (water quality treatment) flow rate. As with any structural stormwater control, the POST system requires regular maintenance. The frequency and type of required maintenance depends on the site selected and the size and character of the tributary drainage basin.

This design guide is recommended for use by engineers when designing and specifying a POST system.

2. FUNCTIONAL DESCRIPTION

The POST system consists of a three-stage vertical filtration media bed and related hydrologic controls. POST Stage 1 is a mulch prefilter that removes gross solids, debris, oils, and larger particulate matter. POST Stage 2 is a primary media bed optimized for the physical filtration of TSS, dissolved pollutant sorption, and plant growth. POST Stage 3 is a polishing media bed specifically formulated for dissolved phosphorus and metals removal. Inflowing stormwater is dispersed evenly across the media bed using a flow dispersion device. Outflowing treated stormwater is routed through an underdrain pipe with an orifice sized to limit the POST media filtration rate and then to an appropriate point of discharge. One or more media beds can be arranged in cells contained within a housing and sized as per the tributary area.

POST system components can be customized to accommodate anticipated flow rates and site-specific constraints. The POST system is typically located within a cement concrete vault or basin but can be constructed within a lined earthen excavation with or without structural walls on one or more sides. Runoff entering the POST system must be dispersed across the media bed using a manifold or level spreader to prevent concentrated, erosive flows from disturbing the media and ensure runoff is evenly spread across the media at all inflow rates. The POST system stages can be arranged in either a stacked-stage, with all three stages atop each other (Figure 2), or unstacked configuration (Figure 3). An unstacked configuration, with Stage 3 located in a separate chamber or basin than Stage 1 and 2, allows access to and monitoring of Stage 3 without removal of the other stages but may increase the overall depth of the system due to an additional underdrain and dispersion system located between Stage 2 and 3.

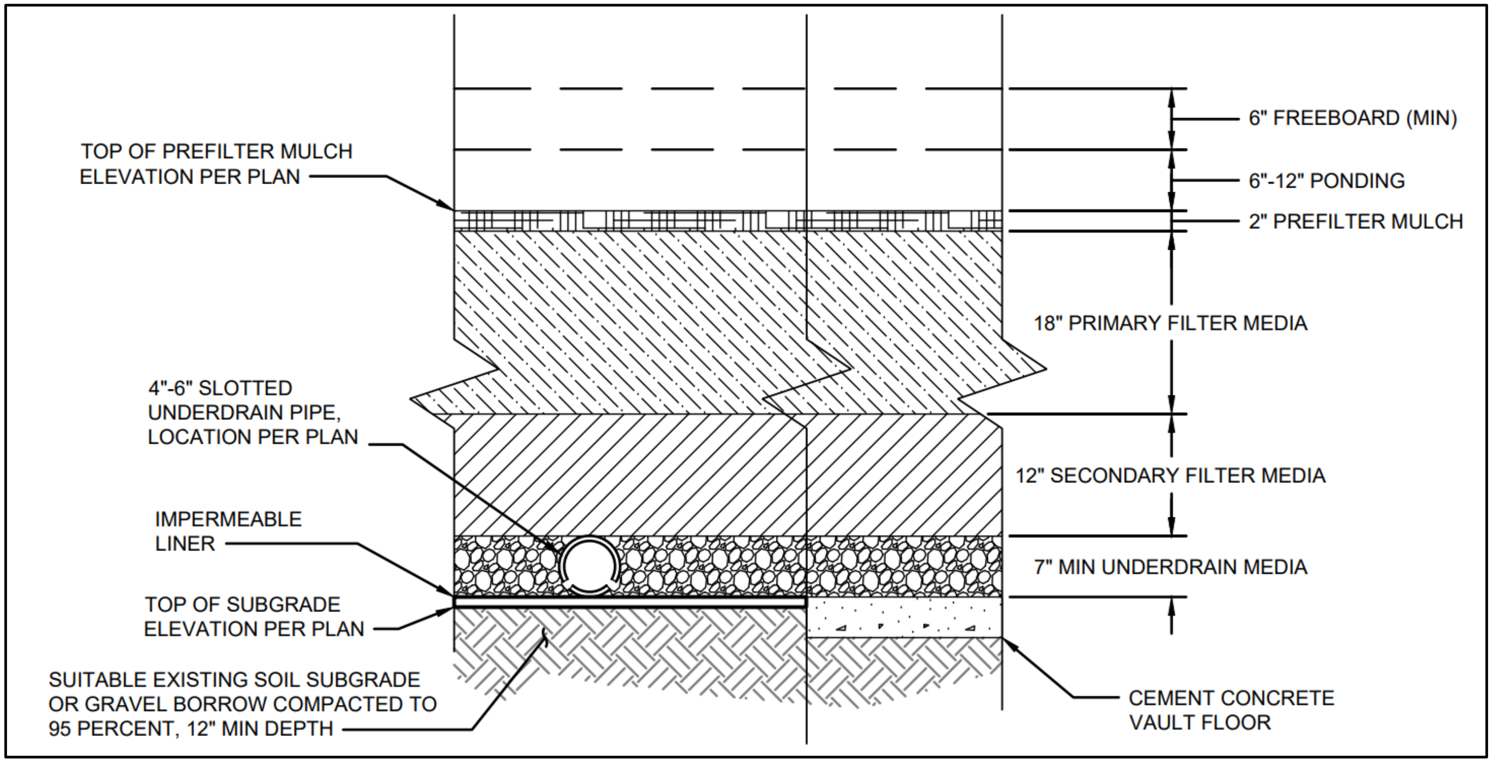

Figure 2. Example Cross Section of the POST System, Stacked-Stage Configuration.

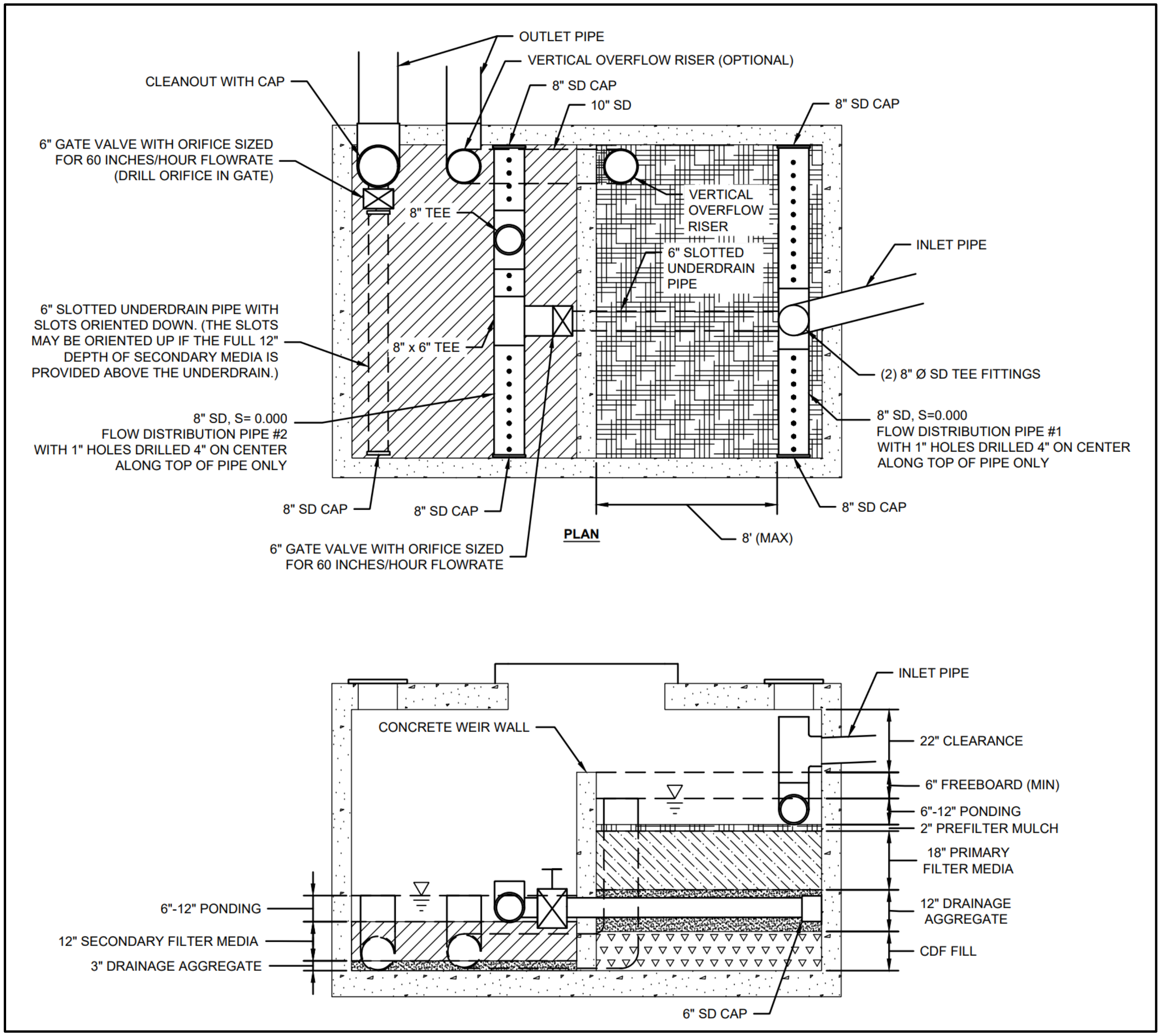

Figure 3. Example Cross Section of the POST System, Unstacked Configuration.

The example two-chambered, unstacked POST system configuration shown in Figure 3 operates as follows.

- Untreated stormwater runoff enters the treatment system vault via piped inflow and is dispersed across the Stage 1 mulch prefilter through a perforated pipe (perforations are only on the top of the pipe) manifold located in Chamber 1. The dispersion manifold pipe is resting on the Stage 1 mulch material. This is an example dispersion device; other appropriate designs can be substituted.
- Inflowing stormwater runoff disperses over the Stage 1 mulch prefilter and flows into the Stage 2 primary media bed where it is collected in a slotted underdrain with orifice and routed into Chamber 2. The orifice controls the filtration rate through Stage 1 and 2.
- Runoff filtered through Stage 1 and 2 is dispersed via a second perforated pipe manifold across and through the Stage 3 polishing media bed. The second dispersion manifold pipe is resting on the Stage 3 polishing material.
- Treated runoff is collected in a slotted underdrain (with orifice) beneath Stage 3 and routed out of the vault. The orifice controls the filtration rate through Stage 3.
- For inflows exceeding the filtration capacity of POST Stage 1 and 2, a vertical riser allows water to bypass the system, including Stage 3. For inflows exceeding the filtration capacity of Stage 3, an optional second vertical riser on the Stage 3 underdrain serves as a high flow bypass. This second vertical riser bypass is optional because very little sediment reaches Stage 3, so clogging of the media is not anticipated.

In a one-chamber, stacked-stage configuration, there is no underdrain beneath Stage 2 and no dispersion manifold atop Stage 3.

2.1. Physical Components

The following section provides descriptions of each physical component of the POST system including vault, inlet, prefilter and media beds, underdrains, and internal bypass.

2.1.1. Filtration Basin

The major components of the POST system are contained in a basin that can be manufactured from cement concrete, polymers, plastics, membranes, or other suitable impermeable material. The basin may be prefabricated and delivered to the project site or field constructed. Depending on site-specific design requirements and preference, the basin may be enclosed with a lid appropriate for site conditions (e.g., traffic rated, ADA-compliant, etc.) or open top to allow access and plant growth in the media. Planting the media is optional, see below.

The POST system may be constructed within a single basin (one chamber) in a stacked-stage configuration or within a partitioned basin with two treatment chambers in an unstacked configuration. In an unstacked configuration, Chamber 1 houses the prefilter (Stage 1) and primary media bed (Stage 2) while Chamber 2 houses the polishing media bed (Stage 3). See Figures 2 and 3.

2.1.2. Inlet

The POST system accommodates multiple inlet configurations. In all cases after runoff enters the system it must be properly calmed and dispersed with a manifold or level spreader to prevent disruption of the media bed. Inlet configuration options include:

- Grated inlet: A grated inlet configuration allows stormwater runoff to enter the filtration basin through a surface grate cast into the filtration basin lid.
- Curb cut: A curb cut configuration allows stormwater runoff to enter the system from a roadway curb and gutter or thickened edge flow line.
- Piped inlet: A piped inlet configuration allows stormwater runoff to enter the filtration basin through a pipe below grade.

Each inlet configuration requires a different vertical positioning of the POST media layers in relation to the inlet, i.e., required hydraulic drop between inlet invert elevation and top of Stage 1 mulch elevation.

2.1.3. Inlet Dispersion

Stormwater runoff entering the POST system must be spread horizontally across Stage 1 via a dispersion device. Inlet dispersion may be accomplished with a perforated pipe manifold, settling pan and weir, or other design. Inlet dispersion design must accommodate the inlet configuration and anticipated inflow rates and be designed in such a way that influent flows are calmed and do not erode the media bed. Inlet dispersion design must accommodate gross solids and other larger debris, e.g., perforation on a perforated pipe manifold must be large enough to pass solids without clogging. Alternatively, gross solids can be captured upstream of the POST system. The flow path length measured from the inlet dispersion device discharge location(s) to any point on the media bed shall be no more than 8 feet. Flow path length is limited to prevent preferential flow through isolated portions of the media near the dispersion device during low flow events.

2.1.4. Prefilter (Stage 1)

The prefilter (Stage 1) consists of a 2-inch-deep layer of ground wood mulch placed on top of the primary media bed (Stage 2). The prefilter mulch helps retain moisture in the media bed for plant survivability, improves runoff dispersion across the media bed, reduces erosion of the media bed during higher flow events, reduces weed growth, and filters gross solids, debris, oils, and larger particulate matter to preserve the life of the underlying primary media bed.

2.1.5. Primary Media Bed (Stage 2)

The primary media bed (Stage 2) consists of an 18-inch-deep layer of engineered treatment media containing 70 percent coarse, clean aggregate, 20 percent coconut coir, and 10 percent high-carbon wood ash (see Appendix A for material specifications). This media blend is optimized for the physical filtration of TSS, sorption of dissolved pollutants, and plant growth.

2.1.6. Polishing Media Bed (Stage 3)

The polishing media bed (Stage 3) consists of a 12-inch-deep layer of advanced treatment media containing 80 percent coarse, clean aggregate, 17 percent activated alumina, and 3 percent iron filings (see Appendix A). It is specifically formulated for dissolved phosphorus and metals removal.

2.1.7. Underdrains

Stormwater is discharged from the POST system via underdrains consisting of slotted well-screen pipe. Perforated underdrains shall not be used. The underdrain may be placed within the media bed, with screen slots located on the bottom of the pipe to ensure the stormwater flow path through the media bed profile is at least the full depth of the media bed. The underdrain may also be placed with the slots oriented up if within a drainage layer consisting of the same coarse clean aggregate used in the primary and polishing media blends. Underdrain cleanouts should be incorporated as appropriate for ease of maintenance. See section 6.1 for details on the underdrain pipe.

The terminus of the underdrains must have an orifice sized such that the maximum filtration rate through the (Stage 2 or Stage 3) media bed is 60 in/hr. The unrestricted media filtration rate is approximately 170 in/hr. An orifice must be used to restrict the rate of discharge and increase contact time between the stormwater and the media. The orifice may be incorporated into the underdrain design by drilling a hole in a cap installed on the end of the underdrain discharge pipe or in the gate of a gate valve.

2.1.8. Bypass

The POST system can be designed with an internal or external high-flow bypass. An internal high-flow bypass consists of a vertical standpipe with a grated inlet, to prevent floating prefilter mulch or other debris from entering the standpipe. An external high-flow bypass may have any one of various configurations. Whether internal or external, no more than 12 inches of driving head (ponding) are allowed on the media before the system goes into bypass. The designer shall configure the inlet and outlet of the treatment cells to avoid any scour of the mulch or treatment media.

2.1.9. Optional Planting

Field testing for TAPE certification was completed without plants. However, plantings are recommended to enhance pollutant uptake (Lucas and Greenway 2008, Muerdter et al. 2018) and to enhance long term hydraulic conductivity of the media bed (WSU 2014). Plantings should be chosen in consultation with an appropriate professional, e.g., a landscape architect, to choose plants suitable for growth in the coarse, low-nutrient media and site-specific environmental factors. The planting guide for bioretention in Appendix One of the 2012 Low Impact Development Guidance Manual for Puget Sound (or current revision/equivalent) can be consulted to help inform the planting design.

If the POST system is planted, vegetation is selected based on durability, aesthetics, local climatic conditions, traffic and pedestrian safety (i.e., may need to limit plant height to maintain visibility or plant width to maintain sidewalk or road clearance), summer drought tolerance, and maintenance considerations (e.g., plants that require minimal pruning, training, and care).

3. TREATMENT PROCESS

The POST system removes pollutants from runoff through settling, screening, filtration, sorption, and biological processing.

3.1. Settling

The POST system removes coarse sediment and floatables through settling. As ponding subsides, the coarse floatables will settle on top of the prefilter (Stage 1).

3.2. Screening

The prefilter mulch layer (Stage 1) acts as an initial screen and allows flow to continue to find a path from the inlet to the primary media bed (Stage 2). The prefilter removes gross solids, debris, oils, and larger particulate matter to preserve the life of the primary media bed.

3.3. Filtration

Filtration occurs as the flow has passed through the prefilter (Stage 1) and enters the primary media bed (Stage 2). Particulate material is removed by filtration as the flow passes through the tightly graded media. The primary media bed is designed to remove the vast majority of the sediment, which prevents fouling of the more expensive polishing media bed (Stage 3).

3.4. Sorption

Sorption is a surface phenomenon and is responsible for the removal of organic and inorganic pollutants through adsorption and ion exchange. Intermolecular forces or attraction cause pollutants to adhere on the solid surfaces of the treatment media. The polishing media bed (Stage 3) has been specifically engineered to sorb dissolved phosphorus and metals.

3.5. Biological Processing

Bacterial growth, supported by the organic soil content and rhizosphere (for planted systems), also provides several treatment processes. These processes vary as a function of moisture, temperature, pH, salinity, pollutant concentrations (particularly toxins), and available oxygen. The following biological treatment processes take place within the POST system: nutrient assimilation, nitrification/denitrification, biodegradation, bioremediation, and phytoremediation. These processes will be enhanced over time if the basin incorporates plantings of grasses and/or shrubs.

4. SIZING

The POST system is configurable to numerous sizes depending on expected influent flows. The POST system is sized per the guidance provided below for western Washington. Sizing tables have not yet been developed for eastern Washington.

4.1. WESTERN WASHINGTON

POST systems designed for use in western Washington are sized using MGSFlood, the Western Washington Hydrology Model (WWHM), or another continuous simulation hydrologic model approved by Ecology, to treat a minimum 91 percent of the annual stormwater volume (Ecology 2019a). The remaining 9 percent of the annual stormwater volume can bypass the POST system. The sizing calculations for each system are determined based on a design filtration rate of 60 inches per hour (in/hr) (or a hydraulic loading rate of 0.62 gpm/ft^2 of primary media surface area).

Using this design target, Table 1 provides a hypothetical contributing area for a selection of potential system dimensions, sized for use in western Washington. The contributing basin area was determined using MGSFlood Version 4.40 assuming a 100 percent impervious basin, off-line treatment, the Seattle 38-inch MAP (mean annual precipitation) precipitation record included with the software, and the default land use parameter values included with the software. This sizing table is provided for example purposes only. The design engineer must use a continuous simulation model with the site-specific contributing area, land use, and precipitation record to accurately size the POST system using the design filtration rate identified above.

The minimum POST size is 12 square feet of treatment media surface area. There is no maximum size for a POST system as long as all flow dispersion and underdrain sizing guidelines are followed per this document. Engineers should use best practices when defining system geometry to ensure that inflowing stormwater is evenly distributed across the media and that flow does not prematurely bypass.

Table 1. POST System Example Dimensions, Design Flow Rates, and Example Contributing Impervious Area for Western Washington.

Length (feet)[a]	Width (feet)[a]	Media Surface Area Chamber 1 (square feet)[b]	Media Surface Area Chamber 2 (square feet)	Hydraulic Loading Rate (gpm/ft^2)	Flow Rate[c] (gpm)	Contributing Area[d] (acres)
Unstacked Chambered Systems						
4	4	8	8	0.62	5	0.13
6	4	12	12	0.62	7.5	0.19
10	6	30	30	0.62	18.7	0.35
12	8	48	48	0.62	29.9	0.76
Stacked Chambered Systems						
4	4	16	NA	0.62	10	0.26
6	4	24	NA	0.62	15	0.38
10	6	60	NA	0.62	37.4	0.95
12	8	96	NA	0.62	59.8	1.52

[a] Other sizes and configurations are feasible, these sizes are used for example purposes only. The minimum media surface area is 12 square feet.

[b] In a stacked chambered system the media footprint is twice the size compared with an unstacked chambered system for the same external vault dimensions.

[c] Assuming 60 inches per hour (in/hr) filtration rate or a 0.62 gallons per minute per square foot (gpm/ft^2) hydraulic loading rate.

[d] Basin area is assumed 100 percent impervious. Sizing for the test system is provided in the *Site Location and System Sizing* section. Basin area modeled using MGSFlood Version 4.40, Seattle 38-inch MAP precipitation record, off-line configuration, and default HSPF land use parameter values.

gpm = gallons per minute

Sizing table intended for planning level use. The design engineer must use an Ecology-approved continuous simulation hydrologic model and site-specific information to calculate the appropriate facility size for installation in western Washington.

5. CONFIGURATIONS

The POST system is typically housed in a precast cement concrete vault; however, the vault can be cast-in-place or another material may be used. Depending on site specific requirements, availability, cost, and designer preference, alternative materials, such as polymers, plastics, membranes, or other impermeable materials, may be designed to house a POST system. The internal components (inlet, prefilter and media beds, underdrains, and bypass) may be assembled either on- or off site prior to installation, depending on site-specific design, materials, availability, and scheduling. Each component must be designed for site-specific application. All components and housing sections (e.g., basin and lid) shall be designed and installed in a manner that results in watertight joints. The vessel shall be designed to avoid groundwater intrusion that could confound the orifice control on the underdrain.

The POST system is typically installed below-grade (underground). Prior to installation, an appropriately sized and shored excavation must be constructed. The bottom of the excavation should be backfilled and leveled with a minimum 6 inches of appropriate material compacted to 95 percent of maximum density. Backfill material, depth, and compaction are specified by the designer and must accommodate the chosen POST system housing material, size, and weight.

Prior to installation, all inlets and outlets should be blocked and covered to prevent contamination of the POST system media beds by construction sediment from the site. The method of delivery and installation depends on the chosen POST system housing and configuration. For example, a precast concrete POST system housing will require delivery of the housing to the site, typically via flatbed truck, and offloading and installation via heavy equipment, such as an excavator or crane. Backfilling around the housing should be performed in a careful manner, placing and compacting approved fill material in 6-inch lifts on all sides. In all instances, installation of the POST system shall conform to ASTM C891 *Standard Practice for Installation of Underground Precast Utility Structures*, unless directed otherwise in contract documents.

5.1. Required Design Elements

- System must be installed as a series of vertically-infiltrating gravity filter beds.
- Influent stormwater must flow passively through the treatment media profile at a design flow rate not exceeding 60 in/hr or 0.62 gallons per minute per square foot (gpm/ft^2) of media surface.
- Filtration rate through the media shall be restricted by an orifice at the terminus of the discharging underdrain.

- The underdrain pipe shall be 4-inch- or 6-inch-diameter Schedule 40 PVC well screen and must have sufficient capacity to pass the design flow rate. The slots shall be cut perpendicular to the long axis of the pipe in rows parallel to the long axis of the pipe.

  A 4-inch-diameter underdrain pipe with a minimum of 15 square inches of open area per linear foot can serve a POST system media bed up to 5 feet wide and a 6-inch-diameter underdrain pipe with a minimum of 24 square inches of open area per linear foot can serve a POST system media bed up to 8 feet wide; assuming the underdrain pipe extends the full length of the media bed. Underdrain slot widths cannot exceed 0.06 inch.

- The underdrain shall be designed in a manner to ensure all influent stormwater filters through the entire 18-inch depth of the primary media bed (Stage 2) and the entire 12-inch depth of the polishing media bed (Stage 3).

- The design should not allow for standing water in the polishing media bed (Stage 3) between storm events.

- POST systems shall not have an open floor or walls; it is a sealed system with no stormwater infiltration to adjacent native or subgrade soils or intrusion of groundwater into the system. After treatment with the POST system, effluent water can be infiltrated with an appropriate BMP (e.g., infiltration gallery, UIC, detention basin) if local site suitability criteria are met.

- Prefilter mulch, primary media bed, polishing media bed, and underdrain drainage layer shall meet all specifications in Appendix A.

- A POST system shall be configured with a high-flow bypass such that no more than 12 inches of ponding depth occurs above the prefilter mulch layer.

- Influent flows shall be dispersed across the media beds to the greatest extent feasible and such that no flow path length from an influent dispersion device to any point on the prefilter media bed is greater than 8 feet. For unstacked configurations, the same maximum flow path length applies to dispersion across the polishing media bed.

- In western Washington, the POST system shall be sized using an Ecology-approved hydrologic model and a design low rate of 0.62 gpm/ft2 of media surface (60 in/hr).

- If influent base flow is present, a design must be implemented to allow the media beds to dry for at least 12 hours out of every 36 hours.

5.2. Optional Design Elements

- POST system primary media beds may be planted or unplanted (recommend planted).
- POST system media may be installed unstacked (TAPE field testing configuration) or stacked (TAPE lab testing configuration).
- POST system may be designed with either an internal or external bypass as long as no more than 12 inches of head (ponding depth) builds above the prefilter mulch layer.

6. INSPECTION AND MAINTENANCE

The POST system is designed for easy maintenance. Routine maintenance is recommended to be performed on a standard unit on an annual basis. During each maintenance servicing, the recommended activities are as follows.

- Inspection of the unit housing structure and media.
- Removal and appropriate disposal of trash, silt, and debris from the prefilter surface.
- Removal and replacement of the prefilter mulch layer.
- Raking of the media to discourage surface occlusion.
- Pruning of vegetation (if present). If the vegetation is dead or in poor health, replace with new vegetation.
- If a non-stormwater liquid spill (e.g., oil or paint) has entered the POST system, replacement of the prefilter, primary, and/or secondary media bed to an appropriate depth is required.

In addition, on a semi-annual basis (every 6 months), it is recommended that a visual inspection be conducted to determine if the prefilter mulch requires replacement. If, during the inspection, it is apparent that the prefilter mulch is occluded, then a mulch replacement is advised. Replacement of the primary and polishing media beds is not generally required until media exhaustion.

The POST system is (preferably) a planted filter with a mulch prefilter. Consequently, the portion of the system that requires the most maintenance is very similar to a bioretention system (i.e., the plants and mulch). Because of this, POST operators should refer to the recommendations in the “Maintenance” section of Volume V, BMP T7.30 Bioretention, in the Stormwater Management Manual for Western Washington (Ecology 2019a).

6.1. ESTIMATED DESIGN LIFE

The non-consumable structural components of the POST system are designed to last 25 years or more before needing maintenance or replacement of internal components. The vault of the system has a use life of up to 50 years depending on the construction materials. On average, the system should be inspected every 6 months and maintained as needed. If the system is inadvertently undersized for the basin or sediment loading is very high, it is expected that more frequent replacement of the prefilter mulch (routine maintenance), will be required. Due to the high variation of loading conditions from site to site, it is recommended that first-year inspections be performed at a more frequent interval to assess the loading condition of the site on the POST system. Based upon this first year of observation, a site-specific maintenance frequency can be established.

7. REFERENCES

Ecology. 2019a. 2019 Stormwater Management Manual for Western Washington: Volume V – Runoff Treatment BMP Design. Washington State Department of Ecology, Olympia, Washington.

Ecology. 2019b. Stormwater Management Manual for Eastern Washington: Chapter V – Runoff Treatment BMP Design. Washington State Department of Ecology, Olympia, Washington.

Lucas, W.C., and M. Greenway. 2008. Nutrient Retention in Vegetated and Nonvegetated Bioretention Mesocosms. Journal of Irrigation and Drainage Engineering-ASCE 134(5):613–623.

Muerdter, C.P., C.K. Wong, and G.H. LeFevre. 2018. Emerging Investigator Series: The Role of Vegetation in Bioretention for Stormwater Treatment in the Built Environment: Pollutant Removal, Hydrologic Function, and Ancillary Benefits. Environmental Science-Water Research & Technology 4(5):592–612.

WSU. 2014. Watershed Protection and Restoration National Estuary Program (Nep) Puget Sound Projects: Progress Report Mesocosm Study. Prepared for Washington State Department of Ecology, by Washington State University, Puyallup, Washington.

APPENDIX A

Media Specification

SECTION 8-05
VACANT

8-05 Vacant ***REVISION***

(CITY OF BELLINGHAM Special Provision)

This section's title is revised to read:

(******)

PHOSPHORUS OPTIMIZED STORMWATER TREATMENT SYSTEM (POST) MEDIA

Section 8-05 is supplemented with the following:

(******)

8-05.1 Description ***NEW***

This work shall consist of procuring components, mixing, testing, and placing stormwater filter mulch, primary treatment media, secondary treatment media, and underdrain bedding intended to provide water quality treatment to surface water runoff in conformity with the lines and grades as shown on the Plans.

8-05.2 Materials ***NEW***

8-05.2(1) Coconut Coir Fiber ***NEW***

1. The Coconut Coir Fiber shall be double rinsed and buffered coco coir.

2. The Coconut Coir Fiber shall also meet the following requirements for quality:

Test/Method	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO_3+NO_2	0.15 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Total Phosphorus	0.5 mg/L (Max.)
	Ortho-phosphorus	0.5 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)
Test Methods for the Examination of Compost and Composting (TMECC) Method 04.10-A	Electrical Conductivity	1.0 mmhos/cm (Max.)

The following suppliers are known for this component:

1. Cocogro Coir Fiber produced by Botanicare, 3204 NW 38th Circle, Vancouver, WA 98660. 888-478-6544. <https://www.botanicare.com/products/cocogro/>.

8-05.2(2) Filter Sand ***NEW***

1. The aggregate shall meet the gradation below and be thoroughly cleaned and free of dirt, clay, silt, asphalt, organic material, or other foreign matter and all aggregate passing the No. 200 sieve size shall be non-plastic.

US Standard Sieve	Percent Passing
4	100
8	30–75
16	5% Max.
30	1% Max.

2. The Sand shall also meet the following requirements for quality:

Test/Method	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO3+NO2	0.15 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Total Phosphorus	0.15 mg/L (Max.)
	Ortho-phosphorus	0.15 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)

The following suppliers are known for this component:

1. Armorstone Epoxy Overlay Aggregate (#4 x #16) from Washington Rock Quarries, Inc. <https://www.wa-rock.com/product/overlay-aggregate/>.

8-05.2(3) High Carbon Wood Ash ***NEW***

1. The High Carbon Wood Ash (HCWA) shall consist of screened and processed organic and inorganic residue remaining after the thermal processing of biomass in an oxygen-controlled environment.

2. The biomass feed-stocks shall be limited to the 1) woody by-products of pacific northwest forestry operations (including cut residues left after a timber harvest, cut trees that are not marketable as lumber), 2) chipped trees and brush from biomass reduction operations (i.e., commercial tree trimming),

and 3) agricultural residues such as nut shells, straw, orchard pruning, seeds, hulls, and pits. The biomass feedstocks shall not include any post-consumer or post-industrial sourced woody biomass (i.e., construction or demolition waste, wood contaminated with paints or sealers, metal, plastic, or other deleterious materials).

3. The HCWA shall be sourced from a producer with at least 5 years of experience producing HCWA for soil amendments and/or water filtration and meet the following requirements for quality and grading:

Test/Method	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO3+NO2	0.15 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Total Phosphorus	0.15 mg/L (Max.)
	Ortho-phosphorus	0.15 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)
Proximate Analysis (ASTM D1762)	Volatile matter	20% (Max.)
	Fixed Carbon	60% (Min.)
	Ash	40% (Max.)
Metals (EPA Method 6020)	Arsenic	20 ppm (Max.)
	Cadmium	10 ppm (Max.)
	Lead	150 ppm (Max.)
	Mercury	8 ppm (Max.)
	Molybdenum	9 ppm (Max.)
	Nickel	210 ppm (Max.)
	Selenium	18 ppm (Max.)
	Zinc	1400 (Max.)
Cation Exchange Capacity (USEPA Method 9081)	milliequivalents CEC/100 g dry soil	Report
Gradation (ASTM D422)	# 6	100% Passing
	#100	10% Passing (Max.)

<u>The following suppliers are known for this component</u>:

1. PD 100+mesh high carbon wood ash from Biological Carbon, LLC; Philomath, Oregon, Contact: John Miedema, 541-619-0007.

8-05.2(4) Activated Alumina *NEW*

The Activated Alumina shall meet the following requirements for quality and grading:

Test/Method	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO_3+NO_2	0.1 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Total Phosphorus	0.1 mg/L (Max.)
	Ortho-phosphorus	0.1 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	1 µg/L (Max.)
Producer Analysis	Alumina (Al_2O_3) content	90% (Min.)
	Bulk density	760 Kg/m^3 (Min.)
	Surface area	300 m^2/g (Min.)
Gradation (ASTM D422) or Producer Analysis	#16 US Standard Sieve (#14 Tyler Mesh)	100% Passing
	#30 US Standard Sieve (#28 Tyler Mesh)	0% Passing

The following suppliers are known for this component:

1. Actiguard F (14 x 28 Mesh) from Axens Canada Specialty Aluminas Inc., 4000 Development Drive, Brockville, Ontario K6V 5V5 Canada; <https://canada.axens.net/>, 613-342-7462.

2. BASF CPN Activated Alumina (14 x 28 Mesh) from BASF Catalysts LLC, 101 Wood Avenue Iselin, NJ https://catalysts.basf.com/products/cpn-activated-alumina 08830-0770, 732-205-5000.

8-05.2(5) Iron Aggregate *NEW*

The Iron Aggregate shall be ground Iron meeting the following requirements for quality and grading:

Test/Method	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO3+NO2	0.1 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Total Phosphorus	0.1 mg/L (Max.)
	Ortho-phosphorus	0.1 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	1 µg/L (Max.)
Producer Analysis	Iron Content by weight	80% – 97%
Gradation (ASTM D422) or Producer Analysis	#4	100% passing
	#8	95 –100% passing
	#16	75–90% passing
	#30	25–45% passing
	#50	0–10% passing
	#100	0–5% passing
	#200	0–2.5% passing

<u>The following suppliers are known for this component</u>:

1. "ETI CC-1004" from Connelly-GPM, Inc., 3154 S. California Avenue, Chicago, IL 60608-5176, <https://www.connellygpm.com/zero-valent-iron>, 773-247-7231.

8-05.2(6) Filter Mulch *NEW*

1. The Filter Mulch shall be derived from cedar or fir only. Filter Mulch shall be produced by grinding the wood stock with a horizontal drum grinder. Filter Mulch shall not be chipped material or bark dust. Mulch shall not contain herbicide, insecticide, weed seed, or weed material. Mulch shall be free of fine organic debris, leaf litter, soil, compost, or any post-consumer or post-industrial sourced woody biomass (i.e., construction or demolition waste, wood contaminated with paints or sealers, metal, plastic, or other deleterious materials). Mulch material shall not contain ground material longer than 3 inches, material smaller than 1/8 inches, or unground branches or twigs.

2. Mulch material shall meet the following loose volume gradation:

Sieve Size	Percent Passing
3″	100%
1/4″	25%

3. The mulch must meet the follow requirements for quality:

Test/Method	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Total Phosphorus	0.15 mg/L (Max.)
	Ortho-phosphorus	0.15 mg/L (Max.)

The following suppliers are known for this component:

1. Lowe's – Premium Brown Hardwood Mulch (item 90954) available in 2 cubic foot bags.

8-05.2(7) Primary Filter Media *NEW*

The Primary Media shall be a blend of the following components in the following ratios.

Component	Ratio (by volume)
Filter Sand	70% (+/- 3%)
Coconut Coir Fiber	20% (+/- 2%)
High Carbon Wood Ash	10% (+/- 1%)

8-05.2(8) Secondary Filter Media *NEW*

The Secondary Media shall be a blend of the following components in the following ratios.

Component	Ratio (by volume)
Filter Sand	80% (+/- 1%)
Activated Alumina	17.5% (+1% / -0%)
Iron Aggregate	2.5% (+0% / -0.25%)

8-05.2(9) Underdrain Media *NEW*

The "Underdrain Media" shall be "Filter Sand."

8-05.3 Construction Requirements *NEW*

8-05.3(1) Submittals *NEW*

1. At least 20 Working Days prior to the blending of the Primary or Secondary Filter Medias the Contractor must submit a "POST Media Blending, Delivery, Protection, and Placement Plan" detailing how the POST Media will be sourced, blended, handled, protected and placed. The submittal must be approved by the Engineer prior to any blending of the POST Media. The dates of the test shall be within 30 days of blending and be taken from the same stockpile, batch, or source as will be used in the blending.

2. At a minimum, the plan must include the information requested on the POST Media Blending, Delivery, Protection, and Placement Plan Form.

3. At least 20 Working Days prior to the placement of the Filter Mulch the following shall be submitted to the engineer:

   (1) A 1-gallon sample of the Filter Mulch.

   (2) The Supplier of the Filter Mulch with contact information.

   (3) A description of the feedstocks grinding equipment to be used.

8-05.3(2) Blending *NEW*

1. The Bioretention Polishing Layer Media shall be mechanically blended to produce a homogeneous mix by a blending vendor/contractor with at least 5 years of soil blending experience. Blending may not commence until the City approves the POST Media Blending, Delivery, Protection, and Placement Plan. The City will issue written acceptance or rejection within 1 week of receiving the complete POST Media Blending, Delivery, Protection, and Placement Plan.

2. The blending shall occur on an impervious (asphalt or concrete) surface pad that has been thoroughly washed clean (e.g., pressure washed) prior to blending or in purpose-built soil blending equipment that has been washed. The blending pad shall be large enough to be able to turn and mix the media without introducing contamination. The blending pad shall be free of standing water before blending and shall be protected from stormwater run-on from off the pad.

3. The measurement of the components to be blended shall be by weight on scale equipment capable of measuring within 1 pound or in full vessels of a known volume. Estimating the volumes of materials of partially full buckets shall not be used. Prior to blending, the coconut coir fiber shall be loose and hydrated such that its density is 4–5 pounds per cubic foot.

4. The materials shall be blended until they are in a homogenous mixed state and then protected from contamination or saturation during storage, delivery, and placement.

5. The Contractor shall notify the engineer at least 72 hours prior to blending of the date, time and place where the blending is to occur so the engineer may attend and observe the blending.

The following vendor(s) are known to meet qualifications:

1. Walrath Landscape Supply, 11405 24th Avenue E, Tacoma, WA 98445, Contact: Greg Miller, 253-531-7499, greg@tewalrath.com.

8-05.3(3) Protection and Placement ***NEW***

1. Media must be protected from rainfall, surface runoff, or contamination including from sediment or other deleterious material from unwashed equipment or other sources while stored off site, in transit, and at the Project Site until incorporated into the Work. After placement the Contractor shall protect the POST media from contamination from silt laden water or other deleterious material.

2. Placing media is not allowed if freezing conditions exist, the area receiving the media has standing water, or the facility is online and receiving stormwater inflow.

3. Place media loosely in even lifts no deeper than 9 inches unless otherwise approved by the City, on the subgrade prepared per these Specifications and in conformity with the lines, grades, depth, and typical cross-section shown on the Drawings or as established by the City. Place the media in lifts that are half the depth of the total media depth. After each lift, rake the surface to a uniform grade, consolidate as specified below, and rake again to scarify before placing subsequent lifts or planting.

4. Final media depth will be measured and verified only after the media has been water consolidated per the approved installation plan. Consolidate the entire surface area of each lift by boot compaction, or using a method approved by City. Final media depth will be measured and verified only after the media has been consolidated per the approved installation plan. Final media depth must be 1 inch above the specified grade for each 1 foot of media placed. After consolidation, if the media is not at final grade, add additional media to bring it up to final grade and rake.

5. After placement of media, notify the City at least 1 Working Day in advance of planned mulch application or planting. The City will reject any cell, or representative area that does not meet the requirements for quality and grading. No payment will be made for the rejected materials and the Contractor must remove and replace the material at no cost to the City.

8-05.4 Measurement *NEW*

1. “POST Media Blending, Delivery, Protection, and Placement Plan,” per Each.
2. “Filter Mulch,” per square yard along the grade and slope of the area covered immediately after placement.
3. “Primary Filter Media,” per cubic yard. Measurement will be made in the hauling conveyance at the point of delivery to the site.
4. “Secondary Filter Media,” per cubic yard. Measurement will be made in the hauling conveyance at the point of delivery to the site.
5. “Underdrain Media,” per cubic yard. Measurement will be made in the hauling conveyance at the point of delivery to the site.

8-05.5 Payment *NEW*

1. “POST Media Blending, Delivery, Protection, and Placement Plan,” per Each.
2. The Bid Item price for “POST Media Blending, Delivery, Protection, and Placement Plan” shall include all costs associated with the development, submittal, and any resubmittal, of this plan. All costs for the implementation of the plan will be considered incidental to the work. These costs will be included in the Bid Item prices for the various Bid Items of Work listed in the Bid Form. 50 percent of the bid price for this item will be paid upon submittal of a complete plan and 50 percent will be paid upon approval of the plan.
3. “Filter Mulch,” per square yard.
4. “Primary Filter Media,” per cubic yard. The unit bid price shall include all tools, equipment, materials, and labor necessary to procure, test, blend, deliver, and place the media.
5. “Secondary Filter Media,” per cubic yard. The unit bid price shall include all tools, equipment, materials, and labor necessary to procure, test, blend, deliver, and place the media.
6. “Underdrain Media,” per cubic yard.

END OF SECTION 8-05

POST MEDIA BLENDING, DELIVERY, PROTECTION, AND PLACEMENT PLAN FORM

BLENDING INFORMATION	
Name of blending vendor/contractor. *Provide: Company Name, Contact Name, Address, Phone, Email*	
Qualifications of blending vendor/contractor. *Provide: Description of qualifications including years of soil blending experience*	
References for blending vendor/contractor. *Provide: 3 references for the blending vendor/contractor*	
Location where soil blending is to occur. *Provide: Address and a description of the site*	
Date for blending. *Provide: Date and time for the soil blending*	
Blending equipment and methods. *Provide: Describe the specific equipment to be used in the soil blending process including the process to wash the equipment and avoid contamination*	
Measurement equipment and methods. *Provide: Describe the specific equipment and methods to be used to measure the components*	

COMPONENT INFORMATION	
Laboratory Information. *Provide for each laboratory used: Name of Lab, Address, Phone number, Contact person with email, Qualifications of the laboratory and personnel including the date of current certification by STA, ASTM, AASHTO, or the Department of Ecology*	
Filter Sand. *Provide: Supplier and product name.* *Attach: Supplier's cut sheet, unit weight, and test results for all component quality parameters listed*	
Coconut Coir Fiber. *Provide: Supplier and product name.* *Attach: Supplier's cut sheet unit weight, and test results for all component quality parameters listed*	
High Carbon Wood Ash. *Provide: Supplier and product name and feedstocks used.* *Attach: Supplier's cut sheet unit weight/density, and test results for all component quality parameters listed*	
Activated Alumina. *Provide: Supplier and product name.* *Attach: Supplier's cut sheet unit weight/density, and test results for all component quality parameters listed*	
Iron Aggregate. *Provide: Supplier and product name.* *Attach: Supplier's cut sheet unit weight/density, and test results for all component quality parameters listed*	

DELIVERY, PROTECTION, AND PLACEMENT	
Delivery. *Provide: A description of how the Phosphorus Optimized Stormwater Treatment System (POST) Media will be delivered to the site (i.e., Super sacks, dump trucks, etc.)*	
Protection. *Provide: A description of how and where the Phosphorus Optimized Stormwater Treatment System (POST) Media will be stored and protected between blending and placement.*	
Placement. *Provide: A description of the sequence of work for how the Phosphorus Optimized Stormwater Treatment System (POST) Media will be placed, shaped, and consolidated.*	